STATUS OF OLIVE CLUBTAIL
Stylurus olivaceus (Selys)
IN BRITISH COLUMBIA

by
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B.C. Ministry of Water, Land and Air Protection
Biodiversity Branch
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ABSTRACT

The Olive Clubtail *(Stylurus olivaceus)* is a dragonfly of warm streams and lakes in western North America. In British Columbia, the species is restricted to a few lakes and warm streams in the Thompson, Kettle and Okanagan valleys. Recent observation or collection records are not known from the Thompson River. Little is known of the biology of the species and no real trend information is available. Possible threats include shoreline development (including loss of riparian vegetation), pesticide contamination, eutrophication and predation by introduced fish. Recommendations include more focused inventory, basic research into the species' biology, maintenance of natural shorelines where possible and control of introduced predatory fish.

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1 SPECIES INFORMATION

1.1 Name and Classification

Selys originally described this species in the genus *Gomphus* (1873, Bull. Acad. Belg. (2) 35:749). *Stylurus* was described by Needham as a subgenus of *Gomphus* in 1897, and subsequent authors (e.g., Williamson 1932; Needham 1948) raised this group to the generic level. Walker (1958), however, was hesitant to accept this designation and retained *Gomphus* in its broader sense; this arrangement was followed by Cannings and Stuart (1977). Since then, however, *Stylurus* has been accepted as a full genus in all official lists (Garrison 2002; Schorr et al. 2002).

Stylurus is derived from the Latin *stylus*, meaning stake or stem, and the Greek urus, referring to the tail; this describes the relatively long, slender abdomen of either the larvae or the adults. The specific epithet *olivaceus* refers to the olive colour of the adult thorax.

Synonyms:

nevadensis Kennedy.

Kennedy described *nevadensis* as a subspecies of *G. olivaceus*, but this subspecies was not recognized in Needham et al. (2000) and Garrison (2002). However, it is recognized in Dunkle (2000). If subspecies are recognized, the form in British Columbia is the nominate *S. olivaceus olivaceus* (Walker 1958).

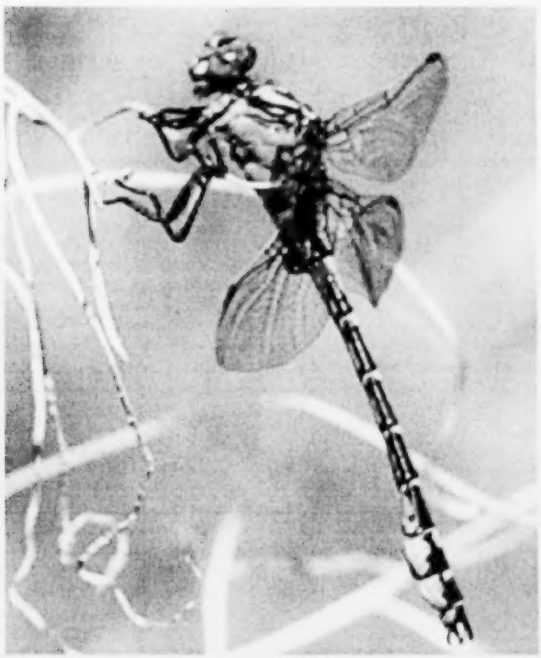

Figure 1. Male Stylurus olivaceus. Photo: D. Paulson.

1.2 Description

As its name suggests, this is a generally grey green species (Figure 1). The adults are 51-54 mm long (Cannings and Stuart 1977) and have a green face with a dark horizontal line; the robust thorax is grey green with broad, black "shoulder" stripes. The abdomen is boldly marked in black with a pale or yellow stripe or spot on the top of each segment, and with yellow on the sides; the yellow is more prominent on the flared segments near the tip of the abdomen (Dunkle 2000; Cannings 2002). The larvae are distinguished by very small burrowing hooks on the tibiae, in contrast to the well-developed hooks in the larvae of the Pronghorn Clubtail (*Gomphus graslinellus*; Cannings and Stuart 1977).

2 BIOLOGY

2.1 General

As in other dragonflies, larvae are aquatic predators, living for about two years in the bottom sediments of streams or lakes until emerging as adults. Adults are aerial predators, returning to the water body to mate and lay eggs.

2.2 Phenology

Most adult flight dates from British Columbia range from 15 July to 1 October (Whitehouse 1941; Royal British Columbia Museum [RBCM] collection records), although a teneral female is recorded from Peachland on 11 June 1913 (E.M. Anderson, RBCM collection). The latter record is extraordinarily early, considering that Washington State flight records range from 8 July to 26 October (Paulson 1999). Cannings (2002) gives the flight period for British Columbia as "mid-July to mid-October." Along the lower Columbia River in Oregon, "adults are easy to find from early August to early November" (J. Johnson, pers. comm.). There are no recorded emergence dates for British Columbia, but teneral adults have been reported on 11 June and 15 July.

2.3 Reproduction

Males do not hold territories as some dragonflies do; instead they patrol the open water frequented by ovipositing females (Corbet 1999). When a male encounters another male over the water, he chases him low over the water (J. Johnson, pers. comm.). Both males and females rest in shrubs and trees. J. Johnson (pers. comm.) has noted very little intraspecific interaction over land; in his experience it is common to see a number of males and females perching within sight of each other or flying past each other, but the males do not act aggressively toward other males or harass females.

On the very wide Columbia River downstream of Portland, Oregon, males are never seen patrolling at or near the shore; when a male is flushed from shore it flies about 100-200 m offshore before beginning any chasing activity (J. Johnson, pers. comm.). On Christina Creek, a much narrower stream (about 10 m wide), males patrol up and down the centre of the river (S. Cannings, pers. obs.). Along the original Okanagan River at Penticton (before channeling), Whitehouse (1941) noted that the males "pursued a zigzag course" in the middle of the river. Males prefer patrolling over "rippling but deep" water (Dunkle 2000), a habit also observed at Christina Creek (L. Ramsay, pers. comm.). The females are "swifter and more direct in their flight than the males" (Kennedy 1917). Copulating pairs head to shore and hang up in trees or shrubs (J. Johnson, pers. comm.). Kennedy (1917) states that the pair "would fly away in a short nuptial flight, soon coming to rest on bushes where they remained in copulation indefinitely."

Females lay eggs by merely dropping them at the surface of the water; J. Johnson (pers. comm.) describes oviposition along the Washougal River in Oregon as "a quick flight down to the middle of the river, three taps of the abdomen, then a quick return to the taller trees." L. Ramsay (pers. comm.) noted females ovipositing in riffles at Christina Creek.

2.4 Survival

No information.

2.5 Physiology

No information.

2.6 Movements/Dispersal

No information.

2.7 Nutrition and Interspecific Interactions

Stylurus larvae are classified as "deep burrowers" by Corbet (1999) and consume bottom-dwelling invertebrates such as chironomids, tubificid worms and burrowing mayflies (Bright and O'Brien 1999). Adults, like other dragonflies, presumably consume a great variety of small, flying insects.

2.8 Behaviour/Adaptability

Adult *Stylurus* are sometimes referred to by the name "hanging clubtails" because they normally perch on trees or large shrubs, in contrast to many other gomphids that prefer to land on the ground (Dunkle 2000; Cannings 2002). The two encountered by Cannings et al. (1998) along the Okanagan River were perched in Siberian elms (*Ulmus pumila* L.). They do, however, perch on the ground on occasion (Dunkle 2000).

3 HABITAT

3.1 Habitat Requirements

Larvae generally burrow in the bottoms of mud- or sand-bottomed rivers or streams (Dunkle 2000). However, in British Columbia, at the northern end of its range, they at least occasionally (and probably regularly) develop along sandy lakeshores (e.g., Okanagan Lake at Peachland, and Vaseux Lake; Cannings and Stuart 1977). Although the species' habitat is described by Needham et al. (2000) as "muddy, often alkaline, western rivers," the streams are probably most often clear. However, they can be "yellow," as a California site is described by Walker (1958). The streams can be as large as the lower Columbia River below Portland (where they are the commonest dragonfly; J. Johnson, pers. comm.), or as small as Christina Creek (about 10 m wide). Christina Creek has large sections of bank consisting of both pebbly/cobbled and sandy/muddy substrates (Cannings et al. 1999). On the lower Columbia River, the species lives commonly within tidal waters and has been observed emerging on rocks exposed only at low tide (A. Emlem, pers. obs., fide J. Johnson). The salinity of the water at this point is not recorded, but may be slightly brackish.

Males prefer to fly over open water, as opposed to along the edge (J. Johnson, D. Paulson, pers. comm.), and prefer to patrol over ripples, where the females often oviposit (Dunkle 2000; L. Ramsay, pers. comm.). Adults rest in riparian shrubs and trees, and also land along the shore (Walker 1958; Cannings et al. 1999). Christina Creek is lined with paper birch (*Betula papyrifera*), white birch (*B. occidentalis*) and alder (*Alnus incana)* (R. Walker, pers. comm.).

S. olivaceus shares its riverine habitats with the Sinous Snaketail (*Ophiogomphus occidentis*), Western River Cruiser (*Macromia magnifica*), Nez Perce Dancer (*Argia emma*) and, at Christina Creek, with the rare River Jewelwing (*Calopteryx aequabilis*). In lake habitats it flies with *Gomphus graslinellus* and *M. magnifica.*

3.2 Trends in Habitat Quality and Quantity

Because the habitat requirements of the larvae are imprecisely known, it is difficult to determine whether there has been a decline in quality and quantity of habitat. Most of the Canadian length of the Okanagan River was channelled in the 1950s (i.e., straightened and levelled, with drop structures put in place; Figures 2, 3 and 4) and presumably this has reduced both quantity and quality of habitat, but no studies have been attempted to demonstrate this.

3.3 Present Habitat Status

The Okanagan River has largely been altered by channelling, as described in Section 3.2. The South Thompson River is relatively natural, except for agricultural development along its banks and the proliferation of some exotic riparian species such as Russian olive (Elaeagnus angustifolia). Residential, tourism and recreational development has altered much of the accessible shorelines of the lakes in the Okanagan and Shuswap regions, as well as Christina Lake. Christina Creek remains largely in a natural state (R. Walker, pers. comm.), with some residential development along its western shores.

3.4 Protection/Ownership

A number of sites are protected or managed for conservation, especially in the Okanagan; however, many of the provincial parks within the distribution of this species (e.g., Sunoka, Bear Creek, Fintry and Ellison parks) are managed primarily for recreation (swimming and boating) and may not adequately protect the littoral and shoreline zones. Protected areas include: South Okanagan Wildlife Management Area, Vaseux-Bighorn National Wildlife Area, Vaseux Lake Provincial Park, Okanagan Mountain Provincial Park, Sunoka Provincial Park, Okanagan Lake Provincial Park, Bear Creek Provincial Park, Fintry Provincial Park, Ellison Lake Provincial Park, Kalamalka Lake Provincial Park, Christina Lake Nature Park (managed locally) and possibly Christina Lake and Gladstone provincial parks. The Nature Conservancy of Canada and Turtle Island Earth Stewards are working to secure conservation covenants on private lands along Christina Creek (K. Blake, R. Durand, pers. comm.).

4 DISTRIBUTION

4.1 Global/North American

Distributed in scattered populations across western North America, from south-central British Columbia south through the interior of Washington, eastern Oregon (reaching almost to the coast along the Columbia River), Idaho, Arizona, Nevada and central California (Figures 5 and 6; Needham et al. 2000; Bick and Mauffray 2002; Nunnallee and Paulson 2002). In Washington State, Paulson (1999) describes the species as "local" in the Columbia Basin and tributaries of the Columbia River in Clark and Cowlitz counties.

4.2 British Columbia

Inhabits warm lakes and warm, lowland rivers in the southern interior. Specifically, it is known from: Christina Creek, just below the outlet of Christina Lake; Okanagan River, just north of Osoyoos Lake; Vaseux Lake; Okanagan River, just below Okanagan Falls; Penticton; Peachland; and Chase and Pritchard along the South Thompson River (Whitehouse 1941; Walker 1958; Scudder et al. 1976; Cannings and Stuart 1977; Cannings et al. 1998, 1999).

5 POPULATION SIZES AND TRENDS

5.1 Population Size

No estimates of population size can be made for British Columbia. Although its behavioural traits of

Figure 2. The Okanagan River flowing through the large marsh at the outlet of Okanagan Lake, Penticton, in 1912. Photo: Penticton Museum.

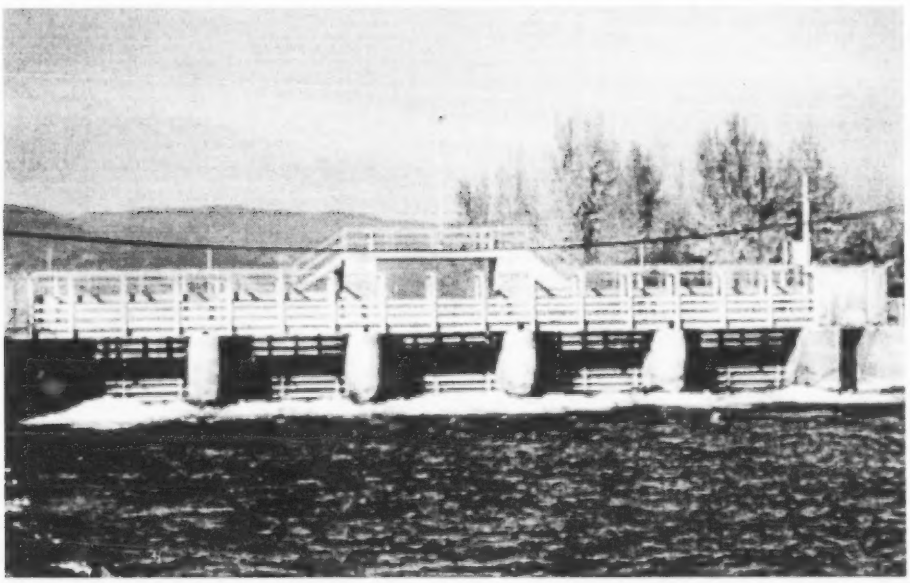

Figure 3. The same site pictured in Figure 2, as seen in 1983. The lake and river levels are now controlled by a dam and the river has been straightened, channelled and bordered by dykes. Photo: R.A. Cannings.

preferring to fly over water and perching on trees may reduce the chances of this species being encountered, *S. olivaceus* is still clearly a very rare species in British Columbia. Despite extensive searches in the south Okanagan in the summer of 1997, Cannings et al. (1998) located it only twice along the Okanagan River, south of Okanagan Falls; they noted that it was considerably rarer than its sympatric cousin, *Ophiogomphus occidentis*.

I estimate that there are probably on the order of 5-10 occurrences of this species in British Columbia, based on a recommended separation distance of 10 km between recognized occurrences (J. Cordeiro, pers. comm.).

5.2 Population Trends

No information for British Columbia. It has apparently declined significantly along the Yakima River in eastern Washington since the late 1980s, but remains common along the Snake River in Idaho and along the Columbia River near its mouth (D. Paulson, pers. comm. in Cannings et al. 1998; J. Johnson, pers. comm.). The channelling of the Okanagan River in British Columbia quite likely has resulted in a decline in the amount and quality of habitat, but the impact of this change is unknown. Whitehouse (1941) described this species as "very scarce" along the Okanagan River in 1938, but he was sampling the area on 18-22 July, relatively early in the flight season.

6 LIMITING FACTORS AND THREATS

6.1 Habitat Loss/Degradation

The primary limiting factor is the presence of appropriate, unpolluted habitat. Much of the species' habitat in the south Okanagan has been altered by river channelling (Cannings et al. 1998). Because the habitat needs of *S. olivaceus* have not been studied in detail, the effect of channelling on its populations is unknown, but could be considerable. In contrast, the habitat structure along Christina Creek remains in a relatively natural state, but this is a very short stream. The distribution along the South Thompson River is not well known.

Urban, residential and marina developments, pollution from power boats, and popular swimming beaches all have potential impact on larval survival.

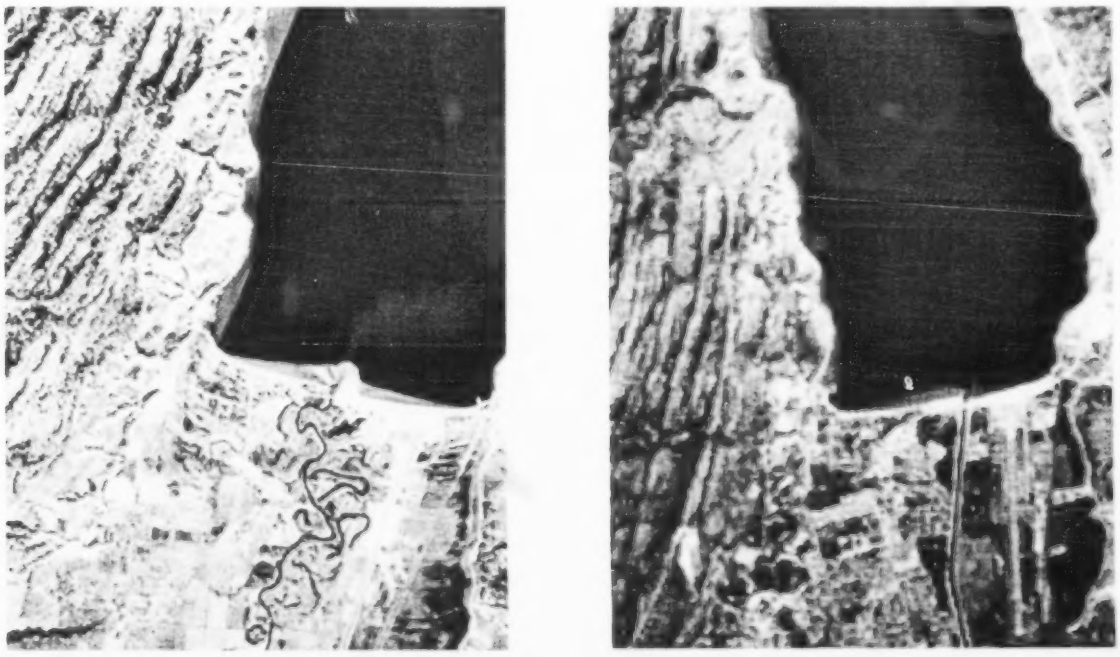

Figure 4. Left: Air photo (BC 800-31) taken of the Okanagan River entering Skaha Lake at Penticton, 1949 (south at top). Right: The same view, taken in 1982 (BC 82024:204).

6.2 Exotic Species

The Okanagan River and associated lakes have had their fish populations altered considerably through the introduction of predatory species such as Large-mouthed Bass (*Micropterus salmoides*), Small-mouthed Bass (*M. dolomieui*), Pumpkinseed (*Lepomis gibbosus)*, Yellow Perch (*Perca flavescens*), Black Crappie (*Pomoxis nigromaculatus*) and Carp (*Cyprinus carpio*). Christina Creek also has substantial populations of all the above species, with the exception of Black Crappie; these exotic species have entered it primarily via introductions into Roosevelt Lake, the reservoir above the Grand Coulee Dam, south of the U.S. border (L. Brazier, B. Jantz, pers. comm.).

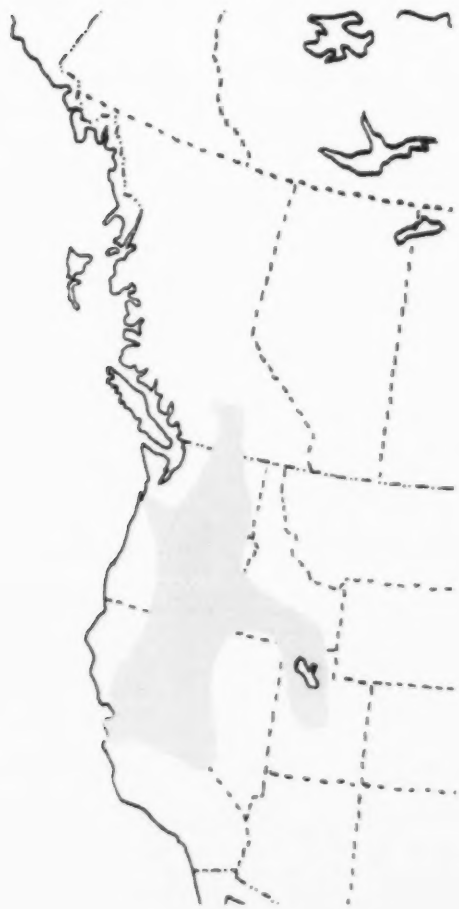

Figure 5. Global distribution of *Stylurus olivaceus* (adapted from Nunnallee and Paulson 2002; Dunkle 2000).

Fish are major predators of odonate larvae (Hilton 1987; Corbet 1999). In an experimental study in North Carolina, 10 times as many dragonfly larvae were found within fish exclusion cages as outside them (Morin 1984). Specifically, bass *(Micropterus* spp.), sunfish (*Lepomis* spp.) and perch (*Perca* spp.) are all known to prey heavily on odonates. In an Iowa study, odonate larvae made up 62-70% of the food of Largemouth Bass greater than 9 cm long (Wright 1946). Large dragonfly larvae were the main food of perch in a Russian study (Pushkin et al. 1979). In Minnesota, coenagrionid damselfly and libellulid dragonfly larvae were prominent among food of Lepomis sunfish (Crowder and Cooper 1982). In Tennessee, Lepomis sunfish preyed heavily on the larvae of *Epitheca cynosura* (a medium-sized corduliid dragonfly); the mean number of larvae per fish when caught was 30 (Martin 1986). Carp not only eat the larvae, but in the Okanagan, and possibly elsewhere, have had a major impact on the vegetation structure of the littoral zone (Cannings et al. 1987).

The Okanagan system and Christina Lake/Creek have also been invaded by Eurasian water-milfoil (*Myriophyllum spicatum*); this aquatic weed is said to be "out of control" at the outlet of Christina Lake (Okanagan Similkameen Boundary Fisheries Partnership 2002). Its effect on habitat suitability for *S. olivaceus* is unknown.

6.3 Pollution/Pesticides

No specific information is available on the effects of pesticides on this species. Pesticides are a potential problem in the South Okanagan, since the Okanagan River flows through many orchard and vineyard lands. In the Saskatchewan River in Saskatchewan, Brimstone Clubtail (*Stylurus intricatus*) larvae were featured in a catastrophic drift of aquatic insects observed 21 and 38 km downstream from a Methoxychlor application site (Dosdall and Lehmkuhl 1989).

Eutrophication through agricultural runoff may be a problem, especially in the Okanagan region. Sewage inputs of nitrates and phosphates have been reduced dramatically in the Okanagan through tertiary treatment

Figure 6. Known county distribution of *Stylurus olivaceus* in the western United States (from Nunnallee and Paulson 2002).

of sewage in the major centres; however, smaller centres and rural areas are not treating sewage in this manner.

7 SPECIAL SIGNIFICANCE OF THE SPECIES

This is the only representative of this genus in British Columbia. Few dragonflies in British Columbia develop in streams; this species may prove to be a good indicator of stream ecosystem health for warm, lowland rivers in the province.

8 EXISTING PROTECTION OR OTHER STATUS

There is no protection offered to invertebrates in British Columbia. The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) has not yet assessed dragonflies; therefore, this species has not been given other status by COSEWIC and, by extension, does not have status under the federal *Species at Risk Act*. Nor has it been given other status under the U.S. *Endangered Species Act*. It is given a global rank of G4 by NatureServe, which indicates a species that is "apparently secure" at present, but for which there are some potential future conservation concerns (NatureServe 2002b). The only other jurisdiction within its range that has ranked their dragonflies is Utah; there *S. olivaceus* is ranked S1S2—imperilled or critically imperilled (NatureServe 2002b).

9 RECOMMENDATIONS AND MANAGEMENT OPTIONS

9.1 Inventory and Research

Since this species is little studied throughout its range, more basic research into its biology and ecology is needed to develop comprehensive management recommendations. Similarly, because its distribution is imperfectly known, and because its lakeshore and riverside habitat is often shared with intensive human use, more precise knowledge of larval distribution would also assist in management (Cannings et al.

Figure 7. Distribution of *Stylurus olivaceus* in British Columbia.

1999). There are no recent records from the South Thompson system, but the species has not been searched for in that region in recent years. Despite a general dragonfly inventory of the Okanagan Valley in 1997 (Cannings et al. 1998), no inventory has been undertaken that specifically focuses on *S. olivaceus* in that region; it is very probable that the 1997 survey missed a number of localities in the south Okanagan. The Kettle River has not been well surveyed either and may also host a population of this species.

9.2 Riparian Zone Management

The protection of riparian zones is probably vital; shrubs and trees in these zones not only provide resting sites and cover for adult dragonflies, but also protect the stream banks from erosion and contribute to in-stream structure. Samways and Steytler (1996) provide recommendations for the width of riparian buffers and vegetation heterogeneity for odonate species assemblages. Although these recommendations do not directly treat *S. olivaceus*, the life requirements of the dragonfly species are similar; these recommendations therefore may be used as starting points for a management plan for this species. *S. olivaceus* also uses habitat away from the river's edge; the area needed by this species remains to be determined.

On Christina Creek, protection of riparian vegetation communities is being actively pursued by The Nature Conservancy of Canada through the creation of conservation covenants on the private land parcels along the stream. The present status of the Crown land along Christina Creek (District Lot 498) is "Government Reserve." This status does not confer any special protection, but local efforts are underway to increase the conservation protection of this key stretch of river (R. Walker, pers. comm.)

9.3 Recreation Management

Control of the amount and type of recreation in the habitat is also important. Of particular concern is the use of personal watercraft along the rivers where this species lives; this is especially so on a narrow stream such as Christina Creek. The wakes from these craft break down the banks (observed directly at Christina Creek) and ultimately collapse the streamside vegetation (Cannings et al. 1999).

9.4 Exotic Species Management

Because introduced fish undoubtedly have had a negative impact on dragonfly larval density (Hilton 1997; Corbet 1999), especially in the Okanagan River system and Christina Creek, one would expect that any control of their density would have a positive effect.

9.5 Pollution Control

Because of the unique qualities of Christina Creek (especially the presence of rare aquatic plants and invertebrates), extra precautions there should be taken to prevent pesticide or other pollution, or eutrophication of the watershed.

10 EVALUATION

10.1 Conservation Data Centre Ranking

Number of Occurrences: B

Probably on the order of 5-10 occurrences in the province.

Number of Occurrences with Good Viability: BC

No studies have been made to estimate viability, but probably several can be expected to persist for many years.

Population Size: U

No thorough inventories have been made to attempt to estimate population size.

Range – Extent of Occurrence: EF

Ranges from the South Thompson River south to Osoyoos and Christina Lake, an area of about 20 000 km^2.

Area of Occupancy: LD

Taking the length of occupied streams and adding the length of possible occupied lake shorelines, this species occupies roughly 350 km of shoreline in British Columbia. By assuming 100 m average width of linear habitat, an area of about 35 km2 can be derived.

Short-term Trend in Population Size, Extent of Occurrence, Area of Occupancy, and/or Number or Condition of Occurrences: U

Unknown.

Long-term Trend in Population Size, Extent of Occurrence, Area of Occupancy, and/or Number or Condition of Occurrences: U

Unknown; although may have declined in population along the Okanagan River.

Threats: B

Scope: Moderate (20-60% of population or area affected) for introduced fish and Eurasian water-milfoil; the percentage of population affected by habitat loss/degradation is more difficult to estimate, but could be Moderate as well.

Severity: Moderate (major reduction of species population or long-term degradation or reduction of habitat in area affected) in terms of introduced fish and aquatic plants.

Imminence: High (threat is happening now).

Number of Appropriately Protected and Managed Occurrences: BC

Habitat protected in a number of provincial parks and other protected areas (see Section 3.4); however, no management is being undertaken in them to ensure protection from introduced fishes and Eurasian water-milfoil, and human recreation use.

10.2 Summary

S. olivaceus is a species that has a spotty distribution throughout its range; in British Columbia, this is particularly so. There are probably on the order of 5-10 occurrences in the province, following the NatureServe (2002a) definition. No data or anecdotal accounts exist to indicate its historical abundance and distribution, and there have been no recent, thorough surveys—population sizes and trends are therefore impossible to determine. It may have declined in numbers and/or lost some populations following the channelling of the Okanagan River. Because of its scattered distribution and restricted range in only a few warm rivers and lakes in the southern interior of British Columbia, and because these areas are subject to a number of threats—such as shoreline development, pesticide and other pollution, habitat degradation from unregulated recreational use and predation/habitat alteration by introduced fish—I recommend retaining the S2 ranking and Red List designation (BCCDC 2003) of this species.

11 AUTHORITIES CONSULTED

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Appendix 1. Historical records of *Stylurus olivaceus* in British Columbia, 1909-1999.

Locatio n	#	Sex		Collector	Day	Mo	Year	Zone	Easting	Northin g	E lev.	Habitat	Collection/ Source	Comments
Christina Cr.					7	8	1999						RBCM	
Christina Cr.					28	8	1999						RBCM	
"Okanagan R., Okanagan Falls"	1	m	Adult	D. St. John	10	9	1997	11U	312700	5469000	339	gravel dyke along river channel	RBCM	
"Okanagan R., Okanagan Falls"	1	m	Adult	D. St. John	9	9	1997	11U	312700	5469000	339	gravel dyke along river channel	RBCM	
Okanagan Falls Park	1	f	Adult	E.M. Anderson	11	7	1913	11U	312700	5468500	339		RBCM	
"Osoyoos L., Okanagan R.; N end of lake at mouth of river"	1	m	Adult	R.A. Cannings	15	7	1981	11U	316000	5439000			RBCM	teneral
Peachland	1	f	Adult	J.B. Wallis	12	8	1909						SEM	"first recor d for Canada, Ent. Soc. Ont. 1910 (pub.)
"Sout h Thompson R., Pritchard"	1	f	Adult	E.R. Buckel l	1	10	1934						SEM	
"Sout h Thompson R., Chase"				"E.M. Walker, F.C. Whitehouse"									PUB	(Walker 1958)
Penticton													PUB	(Walker 1958)
"Penticton, Okanagan R."				R.J. Cannings										sight record
Penticton	1	u	Adult	E.M. Walker	12	7							ROM	
Penticton	1	u	Adult	E.M. Walker	23	7	1926						ROM	